

WHAT IS CLAIMED IS:

1 1. A method of plasma etching, comprising:
2 providing a substrate material;
3 providing a gas for generating a plasma, the gas
4 including a first component and a second component selected
5 such that varying the ratio of the first component to the
6 second component varies the rate of etching of one location of
7 the substrate relative to another location on the substrate;
8 and
9 generating the plasma.

1 2. The method of claim 1, further comprising controlling the
2 rate of etching at a peripheral portion and a central portion
3 of the substrate material by selecting the amount of said
4 first component and second component in the gas.

1 3. The method of claim 2, wherein the rate of etching near
2 the peripheral portion is substantially equal to the rate of
3 etching near the central portion.

1 4. The method of claim 1, wherein said first and second
2 components are selected to generate different ratios of
3 negative ions to electrons within the plasma.

1 5. The method of claim 1, wherein said first component
2 comprises molecules C_xF_y , x and y being integers.

1 6. The method of claim 1 or 5, wherein said second component
2 is selected from the group consisting of silicon fluoride,
3 phosphorous fluoride, and sulfuric fluoride.

1 7. The method of claim 1, wherein the first component
2 comprises molecules C_xF_y , x and y being integers, and the
3 second component comprises SF_6 .

1 8. The method of claim 7, wherein the first component
2 comprises CF_4 .

1 9. The method of claim 1, wherein the volume ratio of the
2 first component to the second component is between about 100:1
3 to 5:1.

1 10. The method of claim 1, wherein the volume ratio of the
2 first component to the second component is between about 50:1
3 to 10:1.

1 11. The method of claim 1, wherein the volume ratio of the
2 first component to the second component is between about 25:1
3 to 15:1.

1 12. The method of claim 1, wherein the plasma is sustained by
2 an electromagnetic field having a frequency of about 13 mega
3 hertz.

1 13. The method of claim 1, wherein the plasma is sustained by
2 a first electromagnetic field having a frequency of about 13

3 megahertz and a second electromagnetic field having a
4 frequency of about 2 magahertz.

1 14. The method of claim 1, wherein the substrate material
2 comprises a semiconductor wafer.

1 15. The method of ~~claim 1~~, wherein the substrate material
2 comprises a quartz plate.

1 16. The method of claim 2, wherein the rate of etching at the
2 peripheral portion at least about 50 mm from the central
3 portion is within about 1% of the rate of etching at the
4 central portion.

1 17. The method of claim 1, wherein the first component is
2 carbon tetrafluoride, the second component is sulfur
3 hexafluoride, the volume ratio of (first component):(second
component) is about 20:1, and the plasma is sustained by a
5 first electromagnetic field having a frequency of about 13
6 megahertz and a second electromagnetic field having a
7 frequency of about 2 megahertz.

1 18. A method of plasma etching, comprising:
2 providing a substrate material,
3 providing a gas for generating a plasma, the gas
4 including a first component comprising molecules C_xF_y , x and y
5 being integers, and a second component selected from the group
6 consisting of silicon fluoride, phosphorous fluoride, and
7 sulfuric fluoride; and
8 generating the plasma.

1 19. The method of claim 18 wherein the first component
2 comprises CF₄ and the second component comprises SF₆.

1 20. The method of claim 18 or 19 wherein the volume ratio of
2 the first component to the second component is about 20:1.

1 21. A method of controlling a plasma, comprising:
2 providing a chamber;
3 providing a gas for generating a plasma in the chamber,
4 the gas including a first component and a second component,
5 wherein the first component produces a positive ion plasma and
6 the second component produces a negative ion plasma;
7 generating the plasma; and
8 controlling the ion distribution within the chamber by
9 selecting the amount of the first component and the second
10 component.

1 22. The method of claim 21 wherein the first component
2 comprises molecules C_xF_y, x and y being integers, and the
3 second component is selected from the group of sulfur
4 fluoride, silicon fluoride, and phosphorus fluoride.

1 23. The method of claim 21 wherein the first component
2 comprises CF₄ and the second component comprises SF₆.

1 24. An apparatus for etching a substrate material comprising:
2 a chamber;
3 a support located within the chamber to support the
4 substrate material;

5 a high frequency energy source;
6 a first gas supply providing a first gas, the first
7 etchant gas comprising $C_x F_y$ molecules, x and y being integers;
8 a first inlet for introducing the first gas into the
9 chamber to form a first plasma gas when energized by the high
10 frequency energy source;

S-10 11 a second gas supply providing a second gas, the second
12 etchant gas comprising $S_p F_q$ molecules, p and q being integers;
13 and

14 a second inlet for introducing the second gas into the
15 chamber to form a second plasma gas when energized by the high
16 frequency energy source.

1 25. The apparatus of claim 24, further comprising a flow
2 controller for controlling the amount of the first and second
3 etchant gases entering the chamber.

1 26. The apparatus of claim 24, wherein the first gas is
2 carbon fluoride and the second gas is sulfuric fluoride.